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| 10/750,021 | 12/30/2003 | Tae-Woo Jung | 51876P542 | 9323 |

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| EXAMINER | |
|---|---|
| JEFFERSON, QUOVAUNDA | |
| **ART UNIT** | **PAPER NUMBER** |
| 2823 | |

DATE MAILED: 09/07/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

| Office Action Summary | Application No. | Applicant(s) |
|---|---|---|
| | 10/750,021 | JUNG ET AL. |
| | Examiner | Art Unit |
| | Quovaunda Jefferson | 2823 |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *10 August 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1-6 and 8-20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-6 and 8-20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

## DETAILED ACTION

### *Continued Examination Under 37 CFR 1.114*

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 10th of August 2006 has been entered.

### *Claim Rejections - 35 USC § 103*

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1, 9-11, 14, and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Huang et al, US Patent 5,976,951 in view of Yu, US Patent 5,801,083 (as cited in previous office actions).

Regarding claim 1, Huang teaches a method for forming a device isolation layer of a semiconductor device, comprising the steps of forming a pad layer pattern **201, 202** defining a device isolation layer on a substrate **200**, wherein the pad layer pattern includes a pad oxide layer **201** and pad nitride layer **202**, forming a trench **204** by etching an exposed portion of the substrate with use of the pad layer pattern as a mask (column 2, lines 24-28), forming a lateral oxide layer **205** on a partial surface of the substrate, the partial surface consisting of sidewalls and a bottom area in the trench, forming a liner nitride layer **208** on the lateral oxide layer, forming an insulation layer **209** on the liner nitride layer **208** to fill the trench, and planarizing the insulation layer until the pad nitride layer is removed (column 4, lines 39-42), and removing the pad oxide layer (column 4, lines 50-52).

Huang fails to teach performing an etching process to make top corners of the trench rounded by controlling an angle of the top corners of the trench according to a contained quantity of hydrogen bromide and chlorine gas in an etching gas and forming a oxide layer by a dry oxidation technique, wherein the dry oxidation technique oxidates the sidewalls and a bottom area in the trench formed by the etching process.

Yu teaches an etching process to make top corners of the trench rounded by controlling an angle of the top corners of the trench according to a contained quantity of hydrogen bromide and chlorine gas in an etching gas (column 3, lines 36-41) because the tapered or sloped edge of the trench can be controlled by the etching conditions

such as gas ratio, pressure, and bias and forming a oxide layer by a dry oxidation technique, wherein the dry oxidation technique oxidates the sidewalls and a bottom area in the trench formed by the etching process (column 3, lines 56-61) as a method to provide an additional insulating barrier layer for the substrate and to aid in decreasing the sharpness of the trench corner since sharp corners of a trench will increase points of high stress, which decreases the reliability of the semiconductor device.

It would be obvious to one of ordinary skill in the art at the time of the invention to combine the teachings of Yu with that of Huang because the tapered or sloped edge of the trench can be controlled by the etching conditions such as gas ratio, pressure, and bias and a method to provide an additional insulating barrier layer for the substrate and to aid in decreasing the sharpness of the trench corner since sharp corners of a trench will increase points of high stress, which decreases the reliability of the semiconductor device is disclosed.

Regarding claim 9, Huang teaches a method for fabricating a semiconductor device, comprising the steps of forming a pad oxide layer **201** and a pad nitride layer **202** defining a device isolation layer on a substrate **200**, forming a trench **204** by etching a surface of the substrate to a predetermined depth, forming a lateral oxide layer **205** on a partial surface of the substrate, the partial surface consisting of sidewalls and bottom area of trench (figure 11), forming a liner nitride layer **208** on the lateral oxide layer, forming an insulation layer **209** on the liner nitride layer to bury the trench, planarizing

the insulation layer until the pad nitride layer is removed (column 4, lines 39-42), removing the pad oxide layer until a surface of the substrate is exposed (column 4, line 50-52 and figure 15), forming an oxide layer **220** on the exposed surface of the substrate (figure 18), and forming a conductive layer **222** for a gate electrode on an entire surface of a structure containing the oxide layer.

Huang fails to teach forming a trench of which top corners are rounded by controlling an angle of the top corners of the trench according to a contained quantity of hydrogen bromide and chlorine gas in the etching gas and forming a lateral oxide layer by oxidizing the sidewalls of the trench and the bottom area of the trench formed by the etching process

Yu teaches forming a trench of which top corners are rounded by controlling an angle of the top corners of the trench according to a contained quantity of hydrogen bromide and chlorine gas in the etching gas (column 3, lines 36-41) because the tapered or sloped edge of the trench can be controlled by the etching conditions such as gas ratio, pressure, and bias and forming a lateral oxide layer by oxidizing the sidewalls of the trench and the bottom area of the trench formed by the etching process (column 3, lines 56-61) as a method to provide an additional insulating barrier layer for the substrate and to aid in decreasing the sharpness of the trench corner since sharp corners of a trench will increase points of high stress, which decreases the reliability of the semiconductor device.

It would be obvious to one of ordinary skill in the art at the time of the invention to combine the teachings of Yu with that of Huang because the tapered or sloped edge of the trench can be controlled by the etching conditions such as gas ratio, pressure, and bias and a method to provide an additional insulating barrier layer for the substrate and to aid in decreasing the sharpness of the trench corner since sharp corners of a trench will increase points of high stress, which decreases the reliability of the semiconductor device is disclosed.

Regarding claim 10, Huang further teaches the step of forming the oxide layer includes the steps of forming a screen oxide layer **218** for a threshold voltage control on the substrate, implanting a dopant for a threshold voltage control by using the screen oxide layer as a mask, removing the screen oxide layer, and forming a gate oxide layer **220** on an exposed surface of the substrate after removing the screen oxide layer (figures 15-18 and column 4, lines 61-67).

Regarding claim 11, Yu further teaches the lateral oxide layer is formed through a dry oxidation technique (column 3, lines 56-61).

Regarding claim 12, Yu further teaches the screen oxide layer and the gate oxide layer are formed through a dry oxidation technique (column 3, lines 56-61 Note: Huang

teaches the screen oxide and gate oxide formation. Yu teaches the dry oxidation method, which can be applied to form the screen oxide and gate oxide).

Regarding claim 14, Yu further teaches the screen oxide layer is formed at a temperature ranging from about 850°C to about 1000°C (column 3, lines 57-60). Huang, and Yu fail to teach a screen oxide with a thickness in a range from about 50 A to about 150 A. However, given the teaching of the references, it would have been obvious to determine the optimum thickness, temperature as well as condition of delivery of the layers involved See *In re Aller, Lacey, and Hall* (10 USPQ 23 3-237) "It is not inventive to discover optimum or workable ranges by routine experimentation. Note that the specification contains no disclosure of ether the critical nature of the claimed ranges or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen dimensions or upon another variable recited in a claim, the Applicant must show that tile chosen dimensions are critical. *In re Woodruff*, 919 f.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Any differences in the claimed invention and the prior art may be expected to result in some differences in properties. The issue is whether the properties differ to such an extent that the difference is really unexpected. *In re Merck & Co.,* 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). Appellants have the burden of explaining the data in any declaration they proffer as evidence of non-obviousness. *Ex parte Ishizaka*, 24 USPQ2d 1621, 1624 (Bd. Pat. App. & Inter. 1992).

An Affidavit or declaration under 37 CFR 1.132 must compare the claimed subject matter with the closest prior art to be effective to rebut a prima facie case of obviousness. *In re Burckel*, 592 F.2d 1175, 201 USPQ 67 (CCPA 1979).

Regarding claim 15, Yu further teaches the gate oxide layer is formed at a temperature ranging from about $850^0$C to about $1000^0$C (column 3, lines 56-61)

Claims 2, 4, 5, 8, 13, 16, 18, and 19 rejected under 35 U.S.C. 103(a) as being unpatentable over Huang and Yu as applied to claims 1, 9, and 11 above, and further in view of Ibok, US Paten 6,180,466 (as cited in previous office actions).

Regarding claim 2, Huang and Yu fails to teach an angle of the top corners of the trench is controlled in a range from about 30° to about 60°. However, Ibok teaches an angle of the top corners of the trench is controlled in a range from about 30° to about 60° (column 4, lines 35-41) because trench corners with a more oblique corner angle cause less stress.

It would be obvious to one of ordinary skill in the art at the time of the invention to combine the teachings of Ibok with that of Huang and Yu because trench corners with a more oblique corner angle cause less stress (Ibok, column 4, lines 39-41).

Regarding claim 4, Huang and Yu fail to teach the etching process proceeds by employing an isotropic etching technique. However, Ibok teaches the etching process proceeds by employing an isotropic etching technique (abstract) because the isotropic etch enables the thermal oxidation to form an oxide liner with rounded edges and reduced stress.

It would be obvious to one of ordinary skill in the art at the time of the invention to combine the teachings of Ibok with that of Huang and Yu because the isotropic etch enables the thermal oxidation to form an oxide liner with rounded edges and reduced stress.

Regarding claim 5, Ibok further teaches an angle of top corners of the trench ranges from about 50° to about 80° through the use of the isotropic etching technique (column 4, lines 35-39).

Regarding claims 8 and 13, Yu further teaches the dry oxidation technique is performed at a temperature of about 900°C to about 1000°C to form the lateral oxide layer with a thickness ranging from about 60 A to about 100 A (column 3, lines 55-60).

Regarding claim 16, Huang and Yu fail to teach at the step of forming the trench of which top corners are rounded in an angle of about 30° to about 60°. However, Ibok at the step the top corners of the trench are rounded in an angle of about 30° to about

60° (column 2, line 15) because trench corners with a more oblique corner angle cause less stress.

It would be obvious to one of ordinary skill in the art at the time of the invention to combine the teachings of Ibok with that of Huang and Yu because trench corners with a more oblique corner angle cause less stress (Ibok, column 4, lines 39-41).

Regarding claim 18, Huang and Yu fail to teach the step of making the top corners of the trench more rounded proceeds by employing an isotropic etching technique. However, Ibok teaches the step of making the top corners of the trench more rounded proceeds by employing an isotropic etching technique (abstract) because the isotropic etch enables the thermal oxidation to form an oxide liner with rounded edges and reduced stress.

It would be obvious to one of ordinary skill in the art at the time of the invention to combine the teachings of Ibok with that of Huang and Yu because the isotropic etch enables the thermal oxidation to form an oxide liner with rounded edges and reduced stress.

Regarding claim 19, Ibok further teaches the top corners of the trench is controlled to have an angle ranging from about 50° to about 80° through the use of the isotropic etching technique (column 4, lines 35-39).

Claims 3 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Huang, Yu, and Ibok as applied to claims 2 and 16 above, and further in view of Downey et al, US Patent 2003/0092273 (as cited in previous office actions).

Regarding claim 3, Yu further teaches the step of performing the etching process includes the steps of performing an etching process by using hydrogen bromide (column 3, lines 11-12), removing a native oxide layer formed after the etching process by using carbon tetrafluoride ($CF_4$) gas (column 3, lines 11-12), performing an etching process with use of a gas containing hydrogen bromide and chloride gas to form the trench with a predetermined depth (column 3, lines 35-37). Huang, Yu, and Ibok fail to teach performing an etching process by using a gas containing $CF_9$ and oxygen ($O_2$) gas to purge the chloride gas from a chamber.

Downey teaches performing an etching process by using a gas containing $CF_9$ and oxygen ($O_2$) gas to purge the chloride gas from a chamber [0004, 0027] because it is known that traces of chlorine left behind in the reaction may result in a catalytic reaction with water left in the process an may result in the creation of harmful corroding species.

It would be obvious to one of ordinary skill in the art at the time of the invention to combine the teachings of Downey with that of Huang, Yu, and Ibok because it is known

that traces of chlorine left behind in the reaction may result in a catalytic reaction with water left in the process an may result in the creation of harmful corroding species.

Regarding claim 17, Yu further teaches the step of forming the trench further includes the steps of performing an etching process by using hydrogen bromide (column 3, lines 11-12), removing a native oxide layer formed after the etching process by using $CF_4$ gas (column 3, lines 11-12), performing an etching process by using a gas containing hydrogen bromide and chlorine gas until the trench has a predetermined depth (column 3, lines 35-37). Huang, Yu, and Ibok fail to teach performing an etching process by using a gas containing $CF_9$ and oxygen ($O_2$) gas to purge the chloride gas from a chamber.

Downey teaches performing an etching process by using a gas containing $CF_9$ and oxygen ($O_2$) gas to purge the chloride gas from a chamber [0027] because it is known that traces of chlorine left behind in the reaction may result in a catalytic reaction with water left in the process an may result in the creation of harmful corroding species.

It would be obvious to one of ordinary skill in the art at the time of the invention to combine the teachings of Downey with that of Huang, Yu, and Ibok because it is known that traces of chlorine left behind in the reaction may result in a catalytic reaction with water left in the process an may result in the creation of harmful corroding species.

Claims 6 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Huang, Yu, and Ibok as applied to claims 4 and 16 above, and further in view of Huang, US Patent 6,225,187, (which will be referred to as Huang"187 –as cited by previous office actions).

Regarding claims 6 and 20, while Ibok further teaches the technique is isotropic etching, Huang, Yu, and Ibok fails to teach the technique uses a gas containing $CF_4$ and $0_2$ gas (column 2, lines 10 and 11). However Huang'187 teaches the technique uses a gas containing $CF_4$ and $0_2$ gas (column 2, lines 10, 11, and 51) as a common dry etchant mixture that used for etching in a semiconductor device.

It would be obvious to one of ordinary skill in the art at the time of the invention to combine the teachings of Huang'187 with that of Huang, Yu, and Ibok because $CHF_3/CF_4/O_2/Ar$ is a common dry etchant mixture that used for etching in a semiconductor device.

### *Conclusion*

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Quovaunda Jefferson whose telephone number is 571-272-5051. The examiner can normally be reached on Monday through Friday, 8AM to 4:30PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Smith can be reached on 571-272-1907. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

QVJ
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